



UNITED STATES PATENT AND TRADEMARK OFFICE

UNITED STATES DEPARTMENT OF COMMERCE
United States Patent and Trademark Office
Address: COMMISSIONER FOR PATENTS
P.O. Box 1450
Alexandria, Virginia 22313-1450
www.uspto.gov

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/625,048	07/23/2003	Katherine Barabash	IL920030014US1	1091

7590 01/25/2007
Stephen C. Kaufman,
Intellectual Property Law Dept.
IBM Corporation
P.O. Box 218
Yorktown Heights, NY 10598

EXAMINER

SAEED, USMAAN

ART UNIT	PAPER NUMBER
----------	--------------

2166

SHORTENED STATUTORY PERIOD OF RESPONSE	MAIL DATE	DELIVERY MODE
3 MONTHS	01/25/2007	PAPER

Please find below and/or attached an Office communication concerning this application or proceeding.

If NO period for reply is specified above, the maximum statutory period will apply and will expire 6 MONTHS from the mailing date of this communication.

Office Action Summary	Application No. 10/625,048	Applicant(s) BARABASH ET AL.	
	Examiner Usmaan Saeed	Art Unit 2166	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) ☒ Responsive to communication(s) filed on 13 November 2006.
- 2a) ☒ This action is **FINAL**. 2b) ☐ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

- 4) ☒ Claim(s) 8-15, 20-23, 38-42, 44, 46 and 48 is/are pending in the application.
- 4a) Of the above claim(s) _____ is/are withdrawn from consideration.
- 5) ☐ Claim(s) _____ is/are allowed.
- 6) ☒ Claim(s) 8-15, 20-23, 38-42, 44, 46 and 48 is/are rejected.
- 7) ☐ Claim(s) _____ is/are objected to.
- 8) ☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☒ The drawing(s) filed on 23 July 2003 is/are: a) ☒ accepted or b) ☐ objected to by the Examiner.
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

- 12) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☐ All b) ☐ Some * c) ☐ None of:
1. ☐ Certified copies of the priority documents have been received.
 2. ☐ Certified copies of the priority documents have been received in Application No. _____.
 3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).
- * See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

- | | |
|--|---|
| 1) <input type="checkbox"/> Notice of References Cited (PTO-892) | 4) <input type="checkbox"/> Interview Summary (PTO-413) |
| 2) <input type="checkbox"/> Notice of Draftsperson's Patent Drawing Review (PTO-948) | Paper No(s)/Mail Date: _____ |
| 3) <input type="checkbox"/> Information Disclosure Statement(s) (PTO/SB/08) | 5) <input type="checkbox"/> Notice of Informal Patent Application |
| Paper No(s)/Mail Date: _____ | 6) <input type="checkbox"/> Other: _____ |

DETAILED ACTION

Response to Amendment

1. Receipt of Applicant's Amendment, filed on 11/13/2006 is acknowledged.
Claims 20, 44 and 48 have been amended. Claims 1-7, 16-19, 24-37, 43, 45, 47, and 49 have been cancelled.

Claim Rejections - 35 USC § 103

2. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

This application currently names joint inventors. In considering patentability of the claims under 35 U.S.C. 103(a), the examiner presumes that the subject matter of the various claims was commonly owned at the time any inventions covered therein were made absent any evidence to the contrary. Applicant is advised of the obligation under 37 CFR 1.56 to point out the inventor and invention dates of each claim that was not commonly owned at the time a later invention was made in order for the examiner to consider the applicability of 35 U.S.C. 103(c) and potential 35 U.S.C. 102(e), (f) or (g) prior art under 35 U.S.C. 103(a).

Claims 12-15, 20-23, 42, 44, 46, and 48 are rejected under 35 U.S.C. 103(a) as being unpatentable over **Printezis et al.** (NPL "A Generational Mostly-Concurrent Garbage Collector").

With respect to claim 12, **Printezis** teaches **a method for collecting garbage in a computing environment, the method comprising:**

"a) tracing a root object to any of its reachable objects in a population of objects" as record all objects directly reachable from the *roots* (globals, stacks, registers) of the system (**Printezis** Page 4 "**Mostly Concurrent Collection (Initial marking pause)**").

"b) marking any of said objects referred to in step a)" as at the same time, initiate a concurrent marking phase, which marks a transitive closure of reachable objects (**Printezis** Page 4 "**Mostly Concurrent Collection (Concurrent marking phase)**").

"c) unmarking a marked card comprising any of said objects" as Figure 1 illustrates the operation of the mostly-concurrent algorithm. In this simple example, the heap contains 7 objects and is split into 4 pages. During the initial marking pause (not illustrated), all 4 pages are marked as clean and object **a** is marked live, since it is reachable from a thread stack. Figure 1a shows the heap halfway through the concurrent marking phase. Objects **b**, **c**, and **e** have been marked. At this point, the mutator performs two updates: object **g** drops its reference to **d**, and object **b** has its

Art Unit: 2166

reference field, which pointed to c, overwritten with a reference to d. The result of these updates is illustrated in Figure 1b. Also note that the updates caused pages 1 and 3 to be dirtied (**Printezis Page 5 “A Concrete Example” & Figure 1**). The examiner interprets a page as a card since the page comprises the objects. The examiner also interprets dirtied page to be marked and clean pages as unmarked.

“d) tracing any marked object on said unmarked card to an unmarked referent object of said marked object

e) marking said unmarked referent object

f) tracing said referent object marked in step e) to any of its reachable objects

g) marking any of said objects referred to in step f)

h) tracing any unmarked root object referent to any of its reachable objects

i) marking any of said objects referred to in step h)” as complete the marking phase by marking from the roots, considering modified reference fields in marked objects as additional roots. Since such fields contain the only references that the concurrent marking phase may not have observed, this ensures that the final transitive closure includes all objects reachable at the start of the final marking phase (Printezis Page 4 “Final marking pause” & Figure 1**). These lines and figure 1 teaches us that there are multiple steps of tracing and marking objects.**

“j) performing any of steps c)-g)” as it may also include some objects that became unreachable after they were marked. These will be collected during the next garbage collection cycle (Printezis Page 4 “Final marking pause”**).**

“k) designating any unmarked object in said population of objects as available for reallocation” as every such path consists either entirely of unmarked objects allocated during marking, or contains at least one marked object (**Printezis** Page 16 **“4.8 Concurrency Issues”**). These lines teach that the unmarked objects are allocated during marking.

“wherein any of steps a)-g) are performed upon said population of objects concurrently with the operation of a mutator upon said population of objects within said computing environment” as a garbage collection algorithm that has been designed to serve as the oldest generation of a generational memory system. It attempts to decrease the worst-case garbage collection pause time, while taking advantage of the benefits of a generational system. It is an adaptation of the “mostly parallel” algorithm of Boehm *et al.* [6]. It usually operates concurrently with the mutator, only occasionally suspending the mutator for short periods (**Printezis** Page 2 **“1.**

Introduction”) and **“wherein any of steps h)-k) are performed upon said population of objects while no mutator operates upon said population of objects within said computing environment”** as there are some ways in which our mostly-concurrent collector has been optimized or modified to work as the older generation in a generational collector. First, we recognize that, for most programs, a large majority of allocation in the older generation will be done via promotion from the young generation. (The remainder is “direct” allocation by the mutator in the older generation, which usually occurs only for objects too large to be allocated in the young generation).

Promotion occurs while mutator threads and the concurrent garbage collector thread

Art Unit: 2166

are suspended, which simplifies matters. We take advantage of this simplification by supporting a *linear allocation mode* during young-generation collection (**Printezis** Page 13 “**4.6 Interaction with Young-Generation Collection**”). The examiner interprets the steps a)-g) as oldest and older generation collection and steps h)-k) as young generation collection. These lines teach us that the mutators are suspended and do not operate for the young generation collection.

Printezis teaches the elements of claim 12 as noted above but does not explicitly disclose the step of “**wherein either of steps a) and f) are performed for a given object only if the card to which the object belongs is not marked.**”

However, **Printezis** discloses “**wherein either of steps a) and f) are performed for a given object only if the card to which the object belongs is not marked**” as Figure 1 illustrates the operation of the mostly-concurrent algorithm. In this simple example, the heap contains 7 objects and is split into 4 pages. During the initial marking pause (not illustrated), all 4 pages are marked as clean and object **a** is marked live, since it is reachable from a thread stack (**Printezis** Page 5 “**A Concrete Example**” & Figure 1). The examiner interprets clean pages as unmarked and dirty pages as marked. In figure 1a pages are unmarked/clean and objects are traced on these cards/pages.

It would have been obvious to one of ordinary skill in the art at the time the invention was made to combine the teaching of the cited references because **Printezis** teaching would have provided a faster tracing by only tracing objects if the card to which they belong are not marked.

Claim 42 and 46 is essentially the same as claim 12 except it sets forth the claimed invention as a system and a computer program and is rejected for the same reasons as applied hereinabove.

With respect to claim 13, **Printezis** teaches “**marking said card if said mutator modifies an object pointer of an object in said card**” as the base generational system, a young-generation collection scans all dirty old-space cards, searching for pointers into the young generation. If none are found, there is no need to scan this card in the next collection, so the card is marked as clean. Before a young-generation collection cleans a dirty card, the information that the card has been modified must be recorded for the mostly-concurrent collector (**Printezis** Page 9 “**4.2 Using the Card Table**”). In figure one when an object pointer is modified the page/card is marked/dirtied.

Claims 21 is same as claim 13 and is rejected for the same reasons as applied hereinabove.

With respect to claim 14, **Printezis** teaches “**wherein any of steps a)-g) are performed concurrently**” as at the same time, initiate a concurrent marking phase, which marks a transitive closure of reachable objects. This closure is *not* guaranteed to contain all objects reachable at the end of marking, since concurrent updates of

Art Unit: 2166

reference fields by the mutator may have prevented the marking phase from reaching some live objects (**Printezis Page 4 “Mostly Concurrent Collection (Concurrent marking phase)”**).

Claims 22 is same as claim 14 and is rejected for the same reasons as applied hereinabove.

With respect to claim 15, **Printezis** teaches “**wherein any of steps h)-j) are performed concurrently**” as at the same time, initiate a concurrent marking phase, which marks a transitive closure of reachable objects. This closure is *not* guaranteed to contain all objects reachable at the end of marking, since concurrent updates of reference fields by the mutator may have prevented the marking phase from reaching some live objects (**Printezis Page 4 “Mostly Concurrent Collection (Concurrent marking phase)”**).

Claims 23 is same as claim 15 and is rejected for the same reasons as applied hereinabove.

With respect to claim 20, **Printezis** teaches **a method for collecting garbage in a computing environment, the method comprising:**

“a) tracing a root object to any of its reachable objects in a population of objects” as record all objects directly reachable from the *roots* (globals, stacks,

Art Unit: 2166

registers) of the system (**Printezis Page 4 “Mostly Concurrent Collection (Initial marking pause)”**).

“b) marking any of said objects referred to in step a)” as at the same time, initiate a concurrent marking phase, which marks a transitive closure of reachable objects (**Printezis Page 4 “Mostly Concurrent Collection (Concurrent marking phase)”**).

“c) unmarking a marked card comprising any of said objects” as Figure 1 illustrates the operation of the mostly-concurrent algorithm. In this simple example, the heap contains 7 objects and is split into 4 pages. During the initial marking pause (not illustrated), all 4 pages are marked as clean and object **a** is marked live, since it is reachable from a thread stack. Figure 1a shows the heap halfway through the concurrent marking phase. Objects **b**, **c**, and **e** have been marked. At this point, the mutator performs two updates: object **g** drops its reference to **d**, and object **b** has its reference field, which pointed to **c**, overwritten with a reference to **d**. The result of these updates is illustrated in Figure 1b. Also note that the updates caused pages 1 and 3 to be dirtied (**Printezis Page 5 “A Concrete Example” & Figure 1**). The examiner interprets a page as a card since the page comprises the objects. The examiner also interprets dirtied page to be marked and clean pages as unmarked.

“d) tracing any marked object on said unmarked card to an unmarked referent object of said marked object

e) marking said unmarked referent object

f) tracing said referent object marked in step e) to any of its reachable objects

g) marking any of said objects referred to in step f)

h) tracing any unmarked root object referent to any of its reachable objects

i) marking any of said objects referred to in step h)” as complete the marking phase by marking from the roots, considering modified reference fields in marked objects as additional roots. Since such fields contain the only references that the concurrent marking phase may not have observed, this ensures that the final transitive closure includes all objects reachable at the start of the final marking phase (**Printezis Page 4 “Final marking pause” & Figure 1**). These lines and figure 1 teaches us that there are multiple steps of tracing and marking objects.

“j) performing any of steps c)-g)” as it may also include some objects that became unreachable after they were marked. These will be collected during the next garbage collection cycle (**Printezis Page 4 “Final marking pause”**).

“k) designating any unmarked object in said population of objects as available for reallocation” as every such path consists either entirely of unmarked objects allocated during marking, or contains at least one marked object (**Printezis Page 16 “4.8 Concurrency Issues”**). These lines teach that the unmarked objects are allocated during marking.

“wherein any of steps a)-g) are performed upon said population of objects concurrently with the operation of a mutator upon said population of objects within said computing environment” as a garbage collection algorithm that has been

Art Unit: 2166

designed to serve as the oldest generation of a generational memory system. It attempts to decrease the worst-case garbage collection pause time, while taking advantage of the benefits of a generational system. It is an adaptation of the "mostly parallel" algorithm of Boehm *et al.* [6]. It usually operates concurrently with the mutator, only occasionally suspending the mutator for short periods (**Printezis** Page 2 "1.

Introduction") and "wherein any of steps h)-k) are performed upon said population of objects while no mutator operates upon said population of objects within said computing environment" as there are some ways in which our mostly-concurrent collector has been optimized or modified to work as the older generation in a generational collector. First, we recognize that, for most programs, a large majority of allocation in the older generation will be done via promotion from the young generation. (The remainder is "direct" allocation by the mutator in the older generation, which usually occurs only for objects too large to be allocated in the young generation). Promotion occurs while mutator threads and the concurrent garbage collector thread are suspended, which simplifies matters. We take advantage of this simplification by supporting a *linear allocation mode* during young-generation collection (**Printezis** Page 13 "4.6 Interaction with Young-Generation Collection"). The examiner interprets the steps a)-g) as oldest and older generation collection and steps h)-k) as young generation collection. These lines teach us that the mutators are suspended and do not operate for the young generation collection.

Printezis teaches the elements of claim 20 as noted above but does not explicitly disclose the step of **"l) at any time relative to performing any of steps a)-g),**

Art Unit: 2166

periodically determining whether a marked card contains at least one of said marked objects, and unmarking any marked card about which it is determined that it does not contain at least one of said marked objects.”

However, **Printezis** discloses “**I) at any time relative to performing any of steps a)-g), periodically determining whether a marked card contains at least one of said marked objects, and unmarking any marked card about which it is determined that it does not contain at least one of said marked objects”** as Figure 1 illustrates the operation of the mostly-concurrent algorithm. In this simple example, the heap contains 7 objects and is split into 4 pages. During the initial marking pause (not illustrated), all 4 pages are marked as clean and object **a** is marked live, since it is reachable from a thread stack. A concurrent sweeping phase follows, and will reclaim the unmarked object **f** (**Printezis** Page 5 “**A Concrete Example**” & Figure 1). The examiner interprets clean pages as unmarked and dirty pages as marked. In figure 1d page 3 is unmarked from being marked.

Further **Printezis** discloses dirty cards are changed to precleaned, which are considered dirty by generational collection, but considered clean in the final mark phase (**Printezis** Page 17, **4.9 Concurrent Precleaning**) and a young generation collection cleans a dirty card, the information that the card has been modified must be recorded for the mostly-concurrent collector (**Printezis** Page 9, **4.2 Using the card table**).

It would have been obvious to one of ordinary skill in the art at the time the invention was made to combine the teaching of the cited references because **Printezis**

Art Unit: 2166

teaching would have provided a faster tracing by unmarking any marked card that does not contain at least one of said marked objects.

Claim 44 is essentially the same as claim 20 except it sets forth the claimed invention as a system and is rejected for the same reasons as applied hereinabove.

Claim 48 is same as claim 20 and is rejected for same reasons as applied hereinabove.

3. Claims 8, 10, 38, and 40 are rejected under 35 U.S.C. 103(a) as being unpatentable over **Printezis et al.** (NPL "A Generational Mostly-Concurrent Garbage Collector") as applied to claims 12-15, 20-23, 42, 44, 46, and 48 above, in view of **Kolodner et al. (Kolodener hereinafter)** (U.S. PGPub No. 2001/0000821).

With respect to claim 8, **Printezis** teaches "**a method according to claim 1 and further comprising: designating any of said objects as "new"**" as care must be taken not to deallocate newly allocated objects. This can be accomplished by allocating objects "live" (i.e., marked), at least during this phase (**Printezis** Page 4 "**Mostly Concurrent Collection (Concurrent sweeping phase)**"). Examiner interprets "live" as "new".

Printezis teaches the elements of claim 8 as noted above but does not explicitly disclose the step of "**deferring the tracing of said "new" objects during plurality of cycles.**"

However, **Kolodner** discloses, **"deferring the tracing of said "new" objects during plurality of cycles"** as these new objects may die quite young, but since they are created black (or changed from white to black), they will not be collected until the next full collection, despite the fact that they die young and could have been collected and reclaimed much earlier (**Kolodner** Paragraph 0136).

It would have been obvious to one of ordinary skill in the art at the time the invention was made to combine the teaching of the cited references because **Kolodner's** teaching would have allowed **Printezis** to increase the collection and reallocation time since there is no risk of "missing" any live object during trace because the second check is obviated since all live objects are going to become old and accordingly no pointer can become inter-generational (i.e. pointing from old to young).

Claim 38 is essentially the same as claim 8 except it sets forth the claimed invention as a system and is rejected for the same reasons as applied hereinabove.

With respect to claim 10, **Printezis** teaches a method according to claim 8 and further comprising:

"periodically unmarking any marked card containing only "new" objects" as figure 1 illustrates the operation of the mostly-concurrent algorithm. In this simple example, the heap contains 7 objects and is split into 4 pages. During the initial marking pause (not illustrated), all 4 pages are marked as clean and object a is marked live, since it is reachable from a thread stack (**Printezis** Page 5 **"A Concrete Example"**

& Figure 1). The examiner interprets clean pages as unmarked and dirty pages as marked. In figure 1a page 3 is unmarked/clean and have unmarked objects on this card/page.

“removing said "new" objects' "new" designation” as first, we recognize that, for most programs, a large majority of allocation in the older generation will be done via promotion from the young generation (**Printezis Page 13 “Interaction with Young-Generation Collection”**). Only the young generations are new but after the promotion to older generation they are not new anymore.

Claim 40 is same as claim 10 except claim 40 sets forth the claimed invention as a system and is rejected for the same reasons as applied hereinabove.

4. Claims 9, 11, 39, and 41 are rejected under 35 U.S.C. 103(a) as being unpatentable over **Printezis et al.** (NPL “A Generational Mostly-Concurrent Garbage Collector”) in view of **Kolodner et al.** (U.S. PGPub No. 2001/0000821) further in view of **Johnson et al.** (**Johnson** hereinafter) (U.S. Patent No. 5,948,113).

With respect to claim 9, **Printezis** teaches **“a method according to claim 8 wherein said designating as "new" step is performed”** as care must be taken not to deallocate newly allocated objects. This can be accomplished by allocating objects “live” (i.e., marked), at least during this phase (**Printezis Page 4 “Mostly Concurrent Collection (Concurrent sweeping phase)”**).

Printezis teaches the elements of claim 9 as noted above but does not explicitly disclose the step of **“if said object is part of an allocation cache from which objects are currently being allocated.”**

However, **Johnson** discloses **“if said object is part of an allocation cache from which objects are currently being allocated”** as the global object manager either allocates the new object directly from memory or attempts to reuse a previously allocated object in a cache of available objects as the new object (**Johnson** Abstract).

It would have been obvious to one of ordinary skill in the art at the time the invention was made to combine the teaching of the cited references because **Johnson’s** teaching would have allowed **Printezis** to advantageously minimize and avoid unnecessary memory fragmentation by re-use of allocated objects.

Claim 39 is same as claim 9 except claim 39 sets forth the claimed invention as a system and is rejected for the same reasons as applied hereinabove.

With respect to claim 11, **Printezis** teaches **“a method according to claim 10 wherein said periodically unmarking and removing steps are performed”** as figure 1 illustrates the operation of the mostly-concurrent algorithm. In this simple example, the heap contains 7 objects and is split into 4 pages. During the initial marking pause (not illustrated), all 4 pages are marked as clean and object a is marked live, since it is reachable from a thread stack (**Printezis** Page 5 **“A Concrete Example”** & Figure 1). First, we recognize that, for most programs, a large majority of allocation in the older

Art Unit: 2166

generation will be done via promotion from the young generation (**Printezis** Page 13 “**Interaction with Young-Generation Collection**”). The examiner interprets clean pages as unmarked and dirty pages as marked. In figure 1a page 3 is unmarked/clean and have unmarked objects on this card/page. Only the young generations are new but after the promotion to older generation they are not new anymore.

Printezis teaches the elements of claim 11 as noted above but does not explicitly disclose the step of “**if said object is part of an allocation cache from which objects are not currently being allocated.**”

However, **Johnson** discloses, “**if said object is part of an allocation cache from which objects are not currently being allocated**” as if a re-use condition is met, the object is kept in the cache as an available object already allocated from memory. However, if the re-use condition is not met, the object is de-allocated from memory (**Johnson** Abstract). The de-allocated object is interpreted as currently not being allocated from cache/memory.

It would have been obvious to one of ordinary skill in the art at the time the invention was made to combine the teaching of the cited references because **Johnson’s** teaching would have allowed **Printezis** to advantageously minimize and avoid unnecessary memory fragmentation by re-use of allocated objects

Claim 41 is same as claim 11 except claim 41 sets forth the claimed invention as a system and is rejected for the same reasons as applied hereinabove.

Response to Arguments

5. Applicant's arguments with respect to claims 12, and 20 have been fully considered but are not persuasive.

Regarding claim 12, applicant argues that **Printezis** does not teach **“tracing an object only if the card to which the object belongs not marked.”**

First of all examiner would like to point out that claim 12 recites **“wherein either of steps a)-f) are performed for a given object only if the card to which the object belongs not marked.”** But on the other hand step c) recites, **“unmarking a marked card comprising any of said objects.”** Therefore step c) contains marked card and the two limitation provided by the applicant are contradicting each other.

In response to the preceding argument, Examiner respectfully submits that **Printezis** does not explicitly disclose the step of **“tracing an object only if the card to which the object belongs not marked.”**

However, **Printezis** discloses **“tracing an object only if the card to which the object belongs not marked”** as Figure 1 illustrates the operation of the mostly-concurrent algorithm. In this simple example, the heap contains 7 objects and is split into 4 pages. During the initial marking pause (not illustrated), all 4 pages are marked as clean and object **a** is marked live, since it is reachable from a thread stack (**Printezis**

Page 5 **"A Concrete Example"** & Figure 1). The examiner interprets clean pages as unmarked and dirty pages as marked. In figure 1a pages are unmarked/clean and objects are traced on these cards/pages.

It would have been obvious to one of ordinary skill in the art at the time the invention was made to combine the teaching of the cited references because **Printezis** teaching would have provided a faster tracing by only tracing objects if the card to which they belong are not marked.

Regarding claim 20, applicant argues that **Printezis** does not teach **"I) at any time relative to performing any of steps a)-g), periodically determining whether a marked card contains at least one of said marked objects, and unmarking any marked card about which it is determined that it does not contain at least one of said marked objects."**

In response to the preceding argument, Examiner respectfully submits that **Printezis** does not explicitly disclose the step of **"I) at any time relative to performing any of steps a)-g), periodically determining whether a marked card contains at least one of said marked objects, and unmarking any marked card about which it is determined that it does not contain at least one of said marked objects."**

However, **Printezis** discloses **"I) at any time relative to performing any of steps a)-g), periodically determining whether a marked card contains at least one of said marked objects, and unmarking any marked card about which it is**

determined that it does not contain at least one of said marked objects” as Figure 1 illustrates the operation of the mostly-concurrent algorithm. In this simple example, the heap contains 7 objects and is split into 4 pages. During the initial marking pause (not illustrated), all 4 pages are marked as clean and object **a** is marked live, since it is reachable from a thread stack. A concurrent sweeping phase follows, and will reclaim the unmarked object **f** (**Printezis** Page 5 “**A Concrete Example**” & Figure 1). The examiner interprets clean pages as unmarked and dirty pages as marked. In figure 1d page 3 is unmarked from being marked.

Therefore the page 3 which is being unmarked does not contain at least one marked object.

Further **Printezis** discloses dirty cards are changed to precleaned, which are considered dirty by generational collection, but considered clean in the final mark phase (**Printezis** Page 17, **4.9 Concurrent Precleaning**) and a young generation collection cleans a dirty card, the information that the card has been modified must be recorded for the mostly-concurrent collector (**Printezis** Page 9, **4.2 Using the card table**).

It would have been obvious to one of ordinary skill in the art at the time the invention was made to combine the teaching of the cited references because **Printezis** teaching would have provided a faster tracing by unmarking any marked card that does not contain at least one of said marked objects.

Conclusion

6. **THIS ACTION IS MADE FINAL.** Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire THREE MONTHS from the mailing date of this action. In the event a first reply is filed within TWO MONTHS of the mailing date of this final action and the advisory action is not mailed until after the end of the THREE-MONTH shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event, however, will the statutory period for reply expire later than SIX MONTHS from the mailing date of this final action.

Contact Information


7. Any inquiry concerning this communication or earlier communications from the examiner should be directed to Usmaan Saeed whose telephone number is (571)272-4046. The examiner can normally be reached on M-F 8-5.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Hosain Alam can be reached on (571)272-3978. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Art Unit: 2166

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).

Usmaan Saeed
Patent Examiner
Art Unit: 2166

Leslie Wong 
Primary Examiner

US
January 19, 2007


HOSAIN ALAM
SUPERVISORY PATENT EXAMINER